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LATEX MODIFIED O.F.C. CONSTRUCTION REPORT

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

LATEX MODIFIED O.F.C.

CONSTRUCTION REPORT

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1.0 Introduction

On September 19, 1985, a trial section of latex modified Open Friction Course (O.F.C.) was placed in the westbound core lanes of Hwy. 401, Contract 85-58. The latex modifier was Polysar Latex 275 and the manufacturer claims that their product enhances the properties of hot mix, such as:

- increased high temperature stability
- improved low temperature flexibility
- retardation of aging
- greatly improved adhesion
- elimination of runoff in O.F.C. mixes

The project was initiated by the Bituminous Section and administered by Central Region Construction Staff. The latex was supplied by Polysar Latex and the paving contractor was Miller Paving.

2.0 Trial Location

The test section is located in the westbound core lanes of Hwy. 401, between Dufferin St. and Keele St. The exact location is shown in Appendix A. The section is approximately 225 m in length and 9.4 m wide covering the two outside lanes and shoulder.

3.0 Mix Description

The surface course for Contract 85-58 was a typical O.F.C. mix with washed steel slag fine and coarse aggregate. It has approximately 65% retained on the 4.75 mm sieve with an 85/100 asphalt cement content of 5.2%. The latex modified O.F.C. was identical except for the addition of latex solids which was 3% by weight of the asphalt cement.

4.0 Construction

The contractor was Miller Paving and the asphalt plant was a batch plant located on Miller Ave. off of Woodbine Ave. All paving was done at night due to traffic constraints.

4.1 Production of Hot Mix

Both normal and latex modified O.F.C. were produced using the same plant. The production of the two mixes was identical up to the time of mixing in the pugmill. Table 1 outlines the difference in mixing procedure between the normal and latex modified mix.

TABLE 1

	Normal Mix	Latex Modified Mix
Batch Size (Tonnes)	4.5	4.5
Dry Mix Time (s)	9	9
Wet Mix Time (s)	35	45
Total Mixing Time (s)	44	54
Maximum Mix Temperature (°C)	140	175
Asphalt Cement Content (%)	5.2	5.2
Latex (% Solids)*	0.0	3.0

*Note: Latex is expressed as a percentage of A.C. content(i.e. 3% of 5.2%).

The latex solution, milky in colour and consistency, contained 69% solids (Figure 1). Approximately 10.3 kg of solution was added per 4.5 tonne batch to achieve the desired 3.0% latex. The manufacturer's suggested proportioning replaces 3% of the asphalt cement with latex but for simplicity the asphalt cement content was not altered.

The latex was introduced directly into the pugmill approximately 10 seconds after the A.C., via the chute normally used for asbestos modifiers (Figure 2). Wet mixing time was extended 10 seconds longer than conventional and therefore the total mixing time per batch was 54 seconds versus 44 seconds for the normal O.F.C. mix. The maximum mixing temperature was also increased from 140° C to 175° C. These changes were suggested by the manufacturer to facilitate dispersion and mixing of the latex.

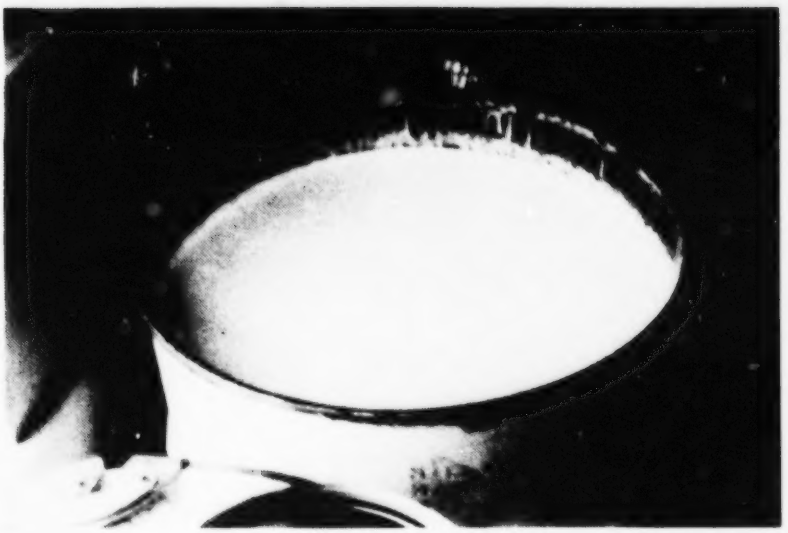


Figure 1

Figure 2

4.2 Paving

Standard paving practices were used with the following exceptions:

1) Liquid soap was added to the water in the roller to avoid pick-up. (Figure 3).

2) The completed mat had to be protected from traffic until it had cooled (approx. 1 hour). Since it was a night paving operation and the mix was placed at the start, this constraint was not a problem.

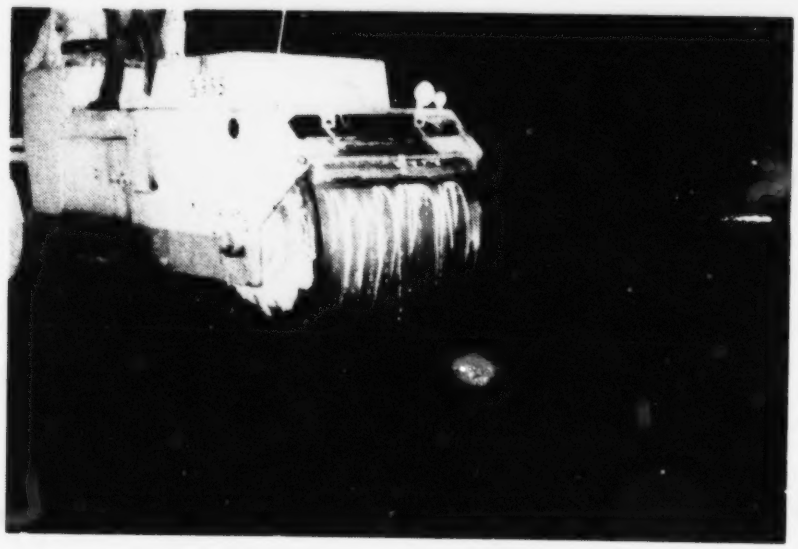


Figure 3

5.0 Observations During Construction

The production of the latex modified mixture went smoothly. The method of latex addition, although crude, was adequate for the small quantity of mix involved.

The latex modified O.F.C. arrived on site at 160° - 170° C. Runoff of asphalt cement, which occurs when other O.F.C. mixes are raised to these temperatures, did not occur. The latex manufacturers had stated previously that runoff would not occur due to the properties of the latex (i.e. increased asphalt cement viscosity).

The manufacturer suggested that the rollers operate very close to the paver in order to achieve proper compaction. It was found, however, that damage and breakage of the mat occurred when the rollers approach too close to the paver. When the rollers stayed further back, the problems disappeared.

Note: The actual thickness of the O.F.C. lift in this area was approximately 40 mm compared to the desired 25 mm.

6.0 Test Results

6.1 Discussion of Test Results.

Samples of asphalt cement, latex and hot mix were obtained during construction. Latex was added to some of the asphalt cement in the lab and both the base and modified asphalt was tested. These results as well as tests on the extracted asphalt cement are shown in Table 2.

From these data it is concluded that:

(a) The base AC is a typical "S" type, that is, the temperature susceptibility for both vicosity and penetration ranges are the same (Figure 4)

(b) Addition of the latex has resulted in a substantial increase in viscosity with only a small change in penetration. A decrease in temperature susceptibility as indicated by an increase in Penetration Index (PI) is shown in both the viscosity and penetration ranges of data with the former being considerably lighter (Figure 4). The significance of this difference and indeed the significance of PI in the viscosity range is not well understood expecially as both are seen to fall off considerably upon oxidation as will be seen later.

(c) The low temperature ductility, nomographic cracking temperature and penetration at 4° C, 200 g/5 sec, all suggest somewhat better low tempertature properties than the virgin AC.

Table 2

COMPARISON OF LABORATORY TEST DATA

Test	Base	Lab Mixture	Mix Extract(1)
Penetration @ 25° C, 100 g/ 5 sec	97	93	-
@ 4° C, 100 g/ 5 sec	10	12	-
@ 4° C, 200 g/60 sec	31	42	-
Penetration Index, (pen/pen)	-1.0	-0.4	-
Penetration Index, (visc/visc)	-0.6	+1.0	-
T800 Pen, °C	44	52	-
Viscosity @ 135° C, mm^2/s	345	1548	-
@ 60° C, Poise	1400	4850	-
Ductility @ 4° C, cm	35	150+	-
Nomographic Cracking Temp., °C	-37	-40	-
TFOT			
Loss, % wt	0.55	0.89	-
Penetration @ 25° C, 100 g/ 5 sec	63	69	47
@ 4° C, 100 g/ 5 sec	8	12	8
@ 4° C, 200 g/60 sec	26	74	25
Penetration Index, (pen/pen)	-0.4	+0.7	+0.6
Penetration Index, (visc/visc)	-0.6	+0.5	-0.2
T800 Pen, °C	50	54	59
Retained Penetration @ 25° C, %	65	74	50 (2)
Viscosity @ 135° C, mm^2/s	474	1430	970
@ 60° C, Poise	2970	7990	9490
Viscosity Ratio, @ 60° C	2.1	1.6	2.0
Ductility @ 4° C, cm	7	85	60
Nomographic Cracking Temp., °C	-37	-43	-40

(1) Extraction from field samples
(2) Based on laboratory mixture as starting quality

(d) Increased softening point (T800 pen) and viscosity at 60° C both indicate potentially better "summer" performance in favour of the latex mixture. However, no information is available to address the problem of creep with this modified AC.

(e) It is noted that TFOT weight loss is comparatively high for the base AC and Latex blend tested.

(f) Results obtained for the base case are what would be expected for a "normal" virgin AC.

(g) The plant mix was made at 175° C or about 35° C higher than normal to accommodate the higher viscosity of the latex blend. It is believed that the higher temperature along with a longer mixing time contributed to the relatively low retained penetration value of 50%.

(h) PI in the penetration range for the two latex containing products remained about the same at about 1.0 unit higher than the base AC. However, PI in the viscosity range reverted to the base AC range and, in fact, somewhat lower. While the significance of PI in the viscosity range is not well understood it is interesting to note that it did revert to the base case. (Figure 5).

(i) The higher operating temperature of the field batch plant has apparently had a detrimental effect on the low temperature quality of the AC/Latex mixture as shown by the lower ductibility and penetration at 4° C.

(j) The penetration at 4° C before and after TFOT of 12 units is in question (100% retained pen) and is reflected in the somewhat better -43° C value for the nomographic cracking temperature.

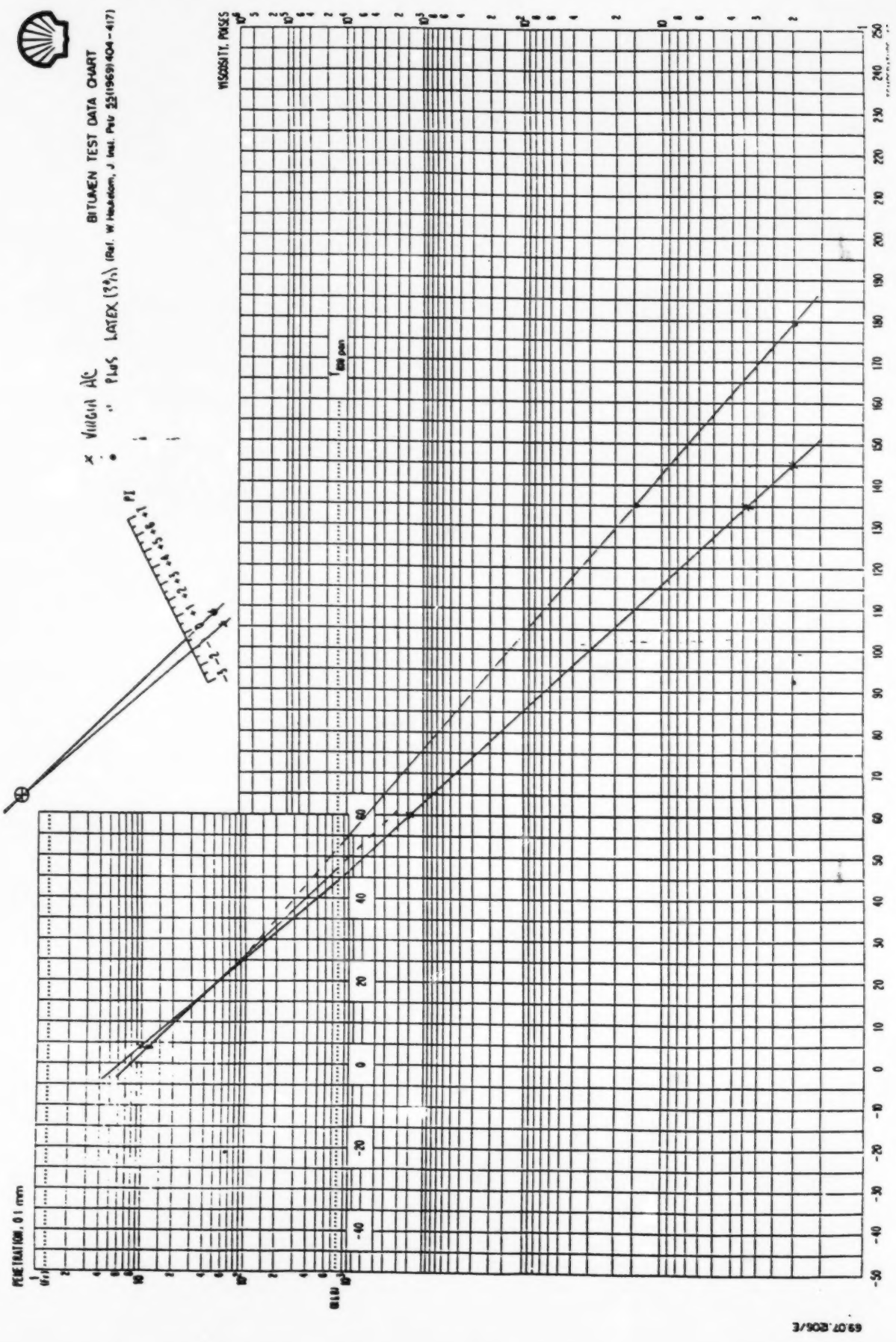
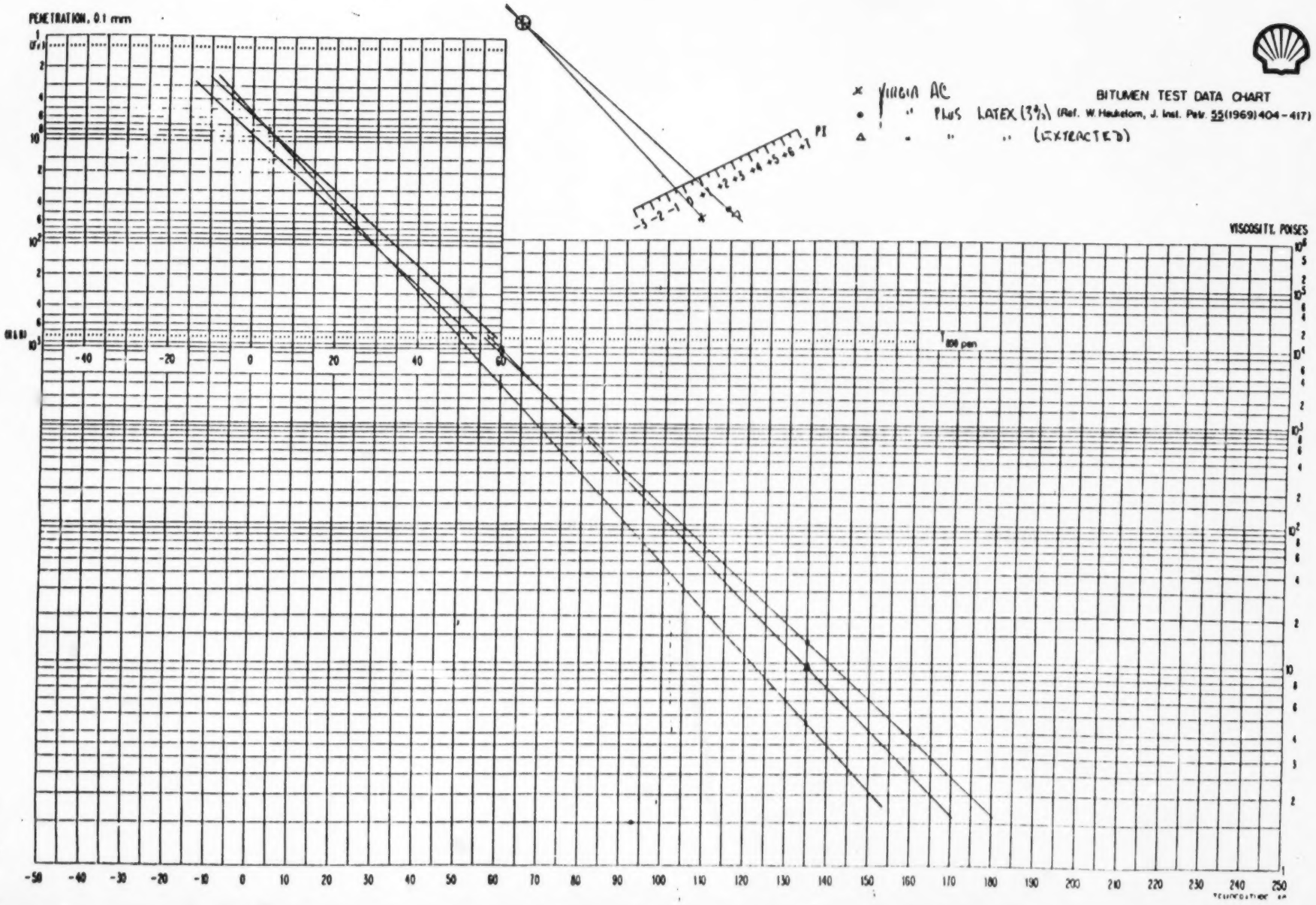

BITUMEN TEST DATA CHART
(Ref. W Heukelom, J Inst. Petr 55(1969)404-417)
x Vialit 4%
• " Plus LATEX (3%)
VISCOSITY, POISES
PENETRATION, 0.1 mm
PI
69.07.8006/E

FIGURE 4

FIGURE 5


PENETRATION, 0.1 mm
VISCOSITY, POISES
BITUMEN TEST DATA CHART
x Virgin AC
• " Plus LATEX (3%) (Ref. W. Heukelom, J. Inst. Pet. 55(1969) 404-417)
△ " " " (EXTRACTED)
PI
800 pen
TEMPERATURE °C

6.2 Summary of Test Results

Summarizing, the addition of latex to the base asphalt has resulted in a substantial increase in viscosity at both 135° C and 60° C along with an increase in ductility at 4° C, PI and a decrease in NCT. This combination suggests improved high and low temperature quality of the resulting pavement. However, attention is drawn to the fact that at least part of the apparent low temperature quality gained through the addition of the latex is lost due to the higher batch plant temperature and longer mixing time.

7.0 Recommendations

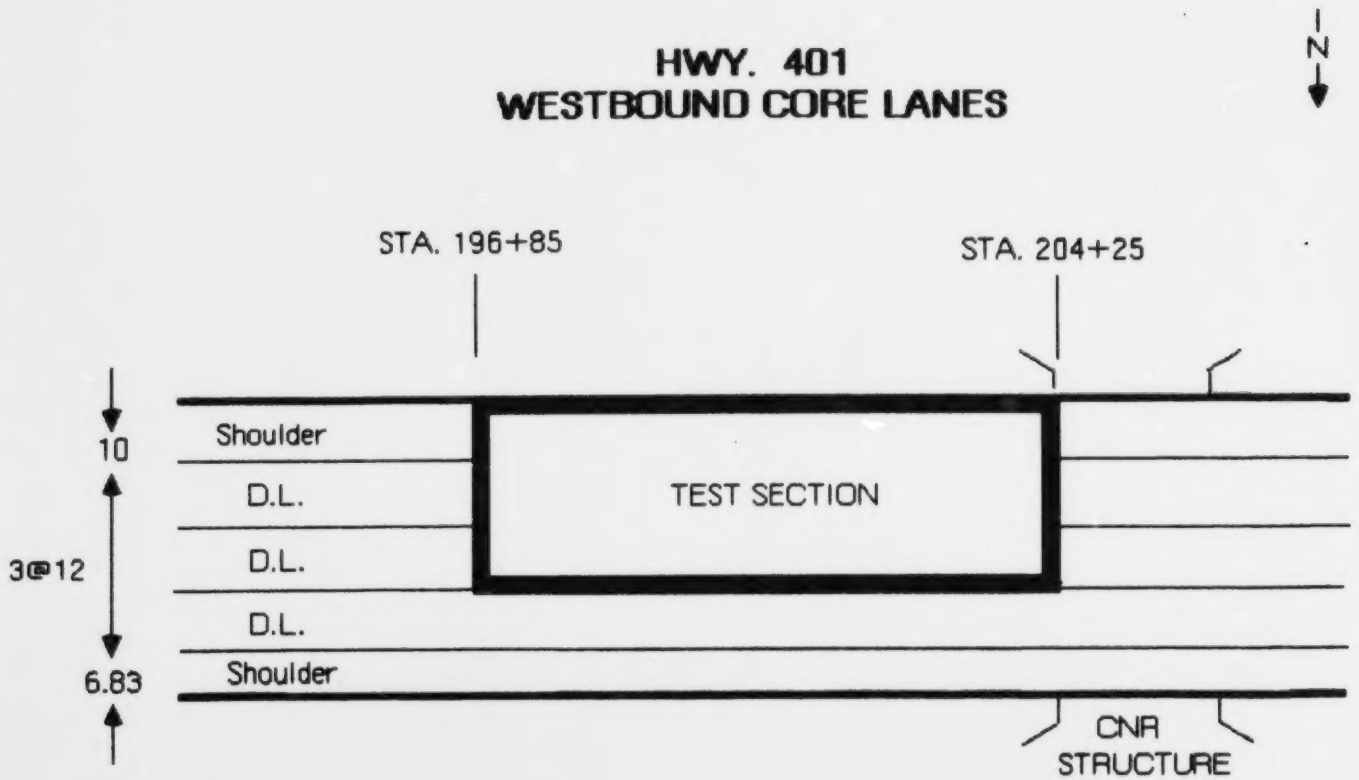
1) This section should be monitored to determine its performance and durability.

8.0 Acknowledgements

A special thanks to all the Central Region Construction and Quality Assurance Staff, especially G. Sholer, J. Castator and C. Rintoul for their invaluable assistance. The co-operation of R. Hayes and R. Moore of Polysar Latex is much appreciated.

Appendix A

HWY. 401
WESTBOUND CORE LANES



N.T.S.
All Units Imperial